LIFE INSURANCE.

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HOW TO FIND OUT
WHAT A LIFE INSURANCE COMPANY OWES YOU.

BY

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HOW TO FIND OUT

WHAT A LIFE INSURANCE COMPANY OWES YOU,

IN CASE A RENEWAL ANNUAL PREMIUM IS NOT PAID.

I.

INTEREST.

As a basis for computing *net* values in life insurance, the State prescribes a table of mortality and rate of interest, upon which these calculations shall be made. The general principles, however, upon which these computations are based, apply to any table of mortality and any rate of interest. In the following discussion it is assumed that the table of mortality is that known as the Actuaries' (Table I., page 22), and that the rate of interest is 4 per cent per annum. In the net calculations, expenses and profits are not considered, these being provided for by an addition to the net premium, called "loading." Net calculations are first made on the supposition that the amount insured is $1, and that the insurance is due at the end of the policy year in which the insured may die.

To obtain the amount that will, at a given rate of interest per annum, compounded annually, become $1 in any given number of years, the rule is:

"*Divide* $1 *by one, plus the rate of interest, and multiply the quotient by itself a number of times equal to the number of years, less one.*"

Calculations have been made by this rule for each year, from 1 to 100 inclusive. The results of these calculations—interest at 4 per cent per annum, and also at 4½ per cent per annum—are given in Table III., page 24.

For full explanation of the foregoing rule, and a general discussion of interest computations, see "NOTES ON LIFE INSURANCE," published by D. VAN NOSTRAND, 23 Murray Street, New York, Third Edition, 1876.

II.

COST OF INSURANCE FOR ONE YEAR.

ASSUME that the age of the insured, at the time of taking out his policy, is, say 40. The table of mortality shows that out of 78,653 persons living at this age, the number that will die before age 41 is 815. Therefore, in case the whole 78,653 living at age 40 are insured for \$1 each, for one year, the insurer will require \$815 at the end of the year, with which to pay \$1 to heirs of each of the 815 who will die before age 41. The amount that will, at 4 per cent, become \$1 in one year is expressed by $\frac{\$1}{1.04}$. From this it follows that $\frac{\$1}{1.04} \times 815$ is the net amount the insurer ought to receive at the beginning of the year, in order that he may have \$815 at the end of the year, with which to pay \$1 to the heirs of each of the 815 persons that will die during the year. The seventy-eight thousand six hundred and fifty-third part of this sum is what each of the 78,653 persons living at age 40 ought to pay at that time, in order to insure \$1 to his heirs at the end of the year, in case he dies during the year. When we have found the net amount that will insure \$1 for one year, multiply this by the actual amount of the policy, and we have the net amount that will effect the insurance called for by the policy. For instance, the amount that will at age 40 insure \$1 for one year, being $\frac{\$1}{1.04} \times \frac{815}{78653}$; multiply this by 1000: the result is \$9.96, plus a fraction of a cent—this is the net amount that will at age 40 insure \$1000 for one year. If we add to this, say 33 per cent for expenses and contingencies, the full or actual premium that will, at age 40, insure \$1000 for one year, is \$13.28.

The annual premium for an ordinary life policy of \$1000 issued at age 40, is usually about \$31 ; varying slightly in different companies. The explanation of this large overcharge is that the *net* cost of insurance each year increases with the age of the insured* and the annual premium being the same each year, it must in the earlier years be more than sufficient to pay the net cost, in order that the company may be able to effect the insurance in the later years without an increase in the annual premium. But suppose a policy-holder discontinues the insurance and fails at any time to pay his renewal annual premium when due : What in this case should be done with the overpayments he has made in previous years ? No one can form an intelligent opinion, in regard to the *equity* of this matter, who does not understand the simple principles upon which computations of *net* money values in this business are based.

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* See Table VII., page 28.

III.

NET SINGLE PREMIUM.

Again assume, for illustration, that the age is 40. We will suppose now that the premium paid at age 40 is to insure \$1, to be paid to heirs of the insured at the end of any year in which he may die.

The net premium that will insure \$1, to be paid at the end of the first year, in case the insured dies between age 40 and age 41, has already been determined. The net premium that will, if paid at age 40, insure \$1 to be paid at the end of the second year, in case the insured dies between age 41 and age 42, is found as follows:

The number living at age 40 is 78,653. Of this number, the table shows that 826 will die between age 41 and age 42. The insurer will, therefore, require \$826 at the end of two years from the time the insurance is effected, in order to enable him to pay at that time \$1 to the heirs of each of those that will die between age 41 and age 42.

The amount that will, at 4 per cent, compounded annually, become \$1 in two years, is expressed by $\frac{\$1}{1.04} \times \frac{1}{1.04} = \$0.924556$. Therefore, $\$0.924556 \times 826$ is the net amount the insurer ought to receive at age 40, in order to insure the 78,653 persons then living, for \$1 each, in case of death *in* the second year. The seventy-eight thousand six hundred and fifty-third part of this sum is the net amount each ought to pay at age 40, to insure \$1 to his heirs at the end of two years from that time, in case he dies between age 41 and age 42.

In a similar manner we find the net amount that will, at age 40, insure \$1 to be paid at the end of three years, in case the insured dies between age 42 and age 43. And so on for each successive year. In case the calculations are made for each year to the table limit of mortality, the insurance is then for life, and the sum of these respective yearly amounts is called the net single premium at that age for whole life insurance. This, at age 40, is \$0.38104

Table IV., page 25, illustrates the manner in which these computations are made at age 50. Similar calculations have been made at each age. (See Table VIII., page 28.)

By reference to the table illustrating in detail the method of calculating the net single premium for whole life, it will be seen that the net premium at any age for effecting insurance, in case of death *in* any designated future year, is determined without reference to the premium for insurance, in case of death *in* any year other than the one designated. Each year stands by itself until we combine them. This may or may not be done, just as the insurer and insured agree. The table of mortality is arranged by years, interest is compounded annually, the insurance is year by year, and the calculations are made for each separate year.

IV.

VALUE, AT ANY AGE, OF A LIFE SERIES OF ANNUAL PAYMENTS OF $1 EACH.

Assume, for the purpose of illustration, that the age of the person is 40, and that the 78,653 persons living at that age, as shown by the table of mortality, are to be paid $1 each, annually, for life, the first payment immediate. The insurer will require $78,653 at the time the contract is made to meet this payment. At the beginning of the second year, age 41, the table shows that 77,838 of the original number will be living. Therefore, the insurer will require $77,838 at the beginning of the second year in order to make the second payment. The amount that will, at 4 per cent, become $1 in one year, is expressed by $\frac{\$1}{1.04}$. Therefore, $\frac{\$1}{1.04} \times 77{,}838$ is the amount the insurer ought to receive at the time the contract is made, in order that he may have, at the beginning of the second year, $77,838 with which to pay $1 to each of those that will be living at age 41. In a similar manner we find the amount he ought to receive at the time the contract is made, in order that he may be able to pay $1 to each of those who will be living at the beginning of each year, to the limit of the table of mortality. The sum of all these yearly amounts is what the insurer ought to receive, at the time the contract is made, in order that he may be able to make all the required payments. The seventy-eight thousand six hundred and fifty-third part of this sum is the amount that ought to be paid to the insurer by each of those living at age 40. These calculations show that, at age 40, the value of a life series of annual payments of $1 each, the first immediate, is $16.0929.

At each age the calculations have been made in a similar manner.

Table V. illustrates in detail the method of making these calculations at age 50.

Table VI. shows the value at each age of a life series of annual payments of $1 each.

V.

NET ANNUAL PREMIUM.

We have already found the net single premium that will at each age insure $1 for life: and we have found the value at each age of a life series of annual payments of $1 each. In illustration of the manner of finding the net annual premium, we will again take age 40. We know that at this age the net single premium that will insure $1 for life, is $0.38104. Now we want to find what sum paid annually for life, the first payment immediate, will be equivalent in value to $0.38104 in hand at age 40. We know that $16.0929 in hand at that age is equivalent in value to a life series of annual payments of $1 each, the first immediate. Therefore, we have the means of forming a proportion in the single rule of three, the fourth term of which, when the proportion is solved, gives the annual premium that will, at age 40, be equivalent in value to the net single premium that will at that age insure $1 for life.

The proportion: "$16.0929 is to $0.38104 as $1 is to the fourth term," will give the value we are seeking. Multiplying the second term by the third, and dividing the product by the first, we find that the fourth term is $0.023677. This is the net annual premium that will, at age 40, insure $1 for life. This is so, because a life series of annual payments of $1 each, beginning at age 40, is equivalent to $16.0929 in hand at that age: and the proportion shows that this being true, $0.023677 paid annually for life, beginning at age 40, is the equivalent of $0.38104 in hand at that age. But $0.38104 paid at age 40 will insure $1 for life; therefore, its equivalent in equal annual payments of $0.023677 each will insure $1 for life.

We find the net annual premium at the other ages in a manner similar to that shown above for age 40. Multiply the net annual premium that will at each age insure $1 for life by 1000, and we have the net annual premium that will at that age insure $1000 for life. (See Table IX., page 28.)

VI.

THE DEPOSIT.

We will now assume that an ordinary life policy for $1000 was issued at age 25. The net annual premium (*Actuaries'* 4 *per cent.* See Table IX., page 28) is $14.72. Suppose this has been regularly paid for twenty years: the policy holder will then have reached age 45. The net annual premium that will at this age insure $1000 for life, is $28.84 (Table IX.), and nothing less than this net annual premium or its equivalent, will at that time effect the insurance. Therefore, the company that receives for insuring $1000 at age 45, a net annual premium $14.72, must have on hand at that time to the credit of this policy, an amount equal to the value at that age of a life series of annual premiums, each equal to $28.84, less $14.72=$14.12. The value at age 45, of a life series of annual payments of $1 each (see Table VI., page 27), is $14.85. Therefore, $14.85 × 14.12= $209.78 is the deposit at age 45 for an ordinary life policy for $1000 issued at age 25.

To find the amount that must be in deposit to the credit of an ordinary whole life policy for $1000, at the end of any policy year: obtain from Table IX., page 28, the net annual premium opposite the age you have attained: then subtract from this the net annual premium opposite your age at the time the policy was issued, and multiply the remainder by the value at your present age of a life series of annual payments of $1 each. For example, suppose an ordinary whole life policy for $10,000 was issued at age 30, and the annual premium has been paid regularly for 20 years. The policy-holder will then have reached age 50. The net annual premium at this age for an ordinary whole life policy of $10,000, is $357.75. (This is derived from Table IX., page 28.) The net annual premium that will, at age 30, insure $10,000 for life is $169.72. (Derived from same table.)

Take $169.72 from $357.75, and we have $188.03: which is the difference between the net annual premium due to age 50 and that which the insured pays. The value at age 50 of a life series of annual payments of $1 each is $13.47. (See Table VI., page 27.) Multiply this by 188.03, and we have $2532.76. This is the sum that ought to be in the hands of the company to the credit of this policy at age 50.

Note.—The amount of paid up insurance for whole life that this deposit will, if used as a net single premium, then purchase is found by using Table VIII., page 28. This table shows that, at age 50, the net single premium that will insure $1000 for life is $481.90. The amount of insurance that the deposit, $2532.76, used as a net single premium, will then purchase is obtained from the following proportion.

$481.90 : $2532.76 :: $1000

is to the insurance for life that the deposit will then purchase. Solving this proportion, we find the amount is $5255. Some deduction ought probably to be made from the deposit, before using it as a net single premium. This, however, will be more fully referred to in another connection.

VII.

A GENERAL ILLUSTRATION, SHOWING THE MANNER IN WHICH THE DEPOSIT ACCUMULATES FROM YEAR TO YEAR.

WE will suppose that a life company insures twenty thousand policy-holders for five thousand dollars each, at age 30. The insurance to be for life, and, we will, in this illustration assume, that no new policy-holders are admitted, and that they all continue the insurance to its maturity. The net annual premium that each will have to pay is $84.85. (This is derived from Table IX., page 28.) The aggregate first payments of these twenty thousand policy-holders is $1,697,000. Interest on this amount for one year, at 4 per cent, is $67,880. The company has, therefore, at the end of the first year, $1,764,880. By the table of mortality, 168* of the insured will die during the first year; to the heirs of each, the company must pay five thousand dollars. The losses by death are, therefore, $840,000 ; leaving on hand with the company, after all the death-claims are paid, $924,880 ; which would be a handsome "*surplus*" at the end of the first year's business, but for the fact that every dollar of this sum belongs to the trust fund deposit, and is an already *accrued liability—a debt.*

At the end of the thirty-fourth year, the deposit for each outstanding policy must be $2464.25. The table of mortality shows that 11,297 of the policy-holders will be living at the end of the thirty-fourth year ; the company must, therefore, have on hand a trust fund deposit amounting to $27,838,632.25. We find that 11,742 policy-holders were living at the beginning of the thirty-fourth year, and their net annual premiums amounted, in the aggregate, to $996,308.70. There were 445 deaths during the year, and the aggregate losses by death amounted to $2,225,000. Thus, in this year, the death-claims exceed the annual premiums by more than one and one quarter millions of dollars. But the company has on hand, in deposit, at the end of the year, $27,838,632.25, after having paid the death-claims. The company, however, is not rich, nor more than able to pay its liabilities, because it will surely take the last cent of this amount, with all the future net annual premiums, and interest compounded regularly all the time, to enable it to meet and pay its now rapidly increasing death-claims.

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* 86292 : 20000 :: 727 : 168.

Let us look into the accounts of the company at the end of the fiftieth year. The "deposit" on account of each policy at the end of this year is $3708.20; and there are living 3080 policy-holders. The aggregate "deposit" for the outstanding policies at this time is $11,421,256. There were 461 deaths during the year, and the aggregate of policies that matured during the year amounted to $2,305,000. There were 3541 policy-holders living at the beginning of the year, and the aggregate of the net annual premiums paid by them amounted to $300,453.85. We see from this, that the losses by death during the year exceeded the net annual premiums by more than $2,000,000. The "deposit" is reduced to $11,421,256, which is less than one half the amount in "deposit" at the end of the thirty-fourth year. But the company has not lost money, it has only been paying its debts. At the end of the thirty-fourth year it had more, but it owed more. It had enough then, and only enough, to pay what it owed; it is in the same condition now.

At the end of the sixty-fifth year, we find the "deposit" that must be in the hands of the company to the credit of each policy is $4560.87; and there are twenty of the original policy-holders living. The aggregate "deposit" for these twenty outstanding policies is $91,217.40. The $27,838,632.25 that the company had on hand at the end of the thirty-fourth year is now reduced to less than $100,000. But the company has only been paying its debts to policy-holders—not losing money. In fact, it had none to lose *of its own.*

At the end of the sixty-ninth year, the "deposit" amounts to $4722.84; and there is *one* policy-holder living. He pays his regular net annual premium the day he is ninety-nine years old. The premium is $84.85. This, added to the "deposit" on hand at the end of the preceding year, makes $4807.69 of this policy-holder's money in the hands of the company the day the policy-holder is ninety-nine years old. At net interest, which is four per cent, the interest for the year will amount to $192.31; and this, added to the amount, $4807.69, on hand at the beginning of the year, makes $5000, with which to pay the policy of the last policy-holder in this company.

We see that the $27,838,632.25, which the company had in its possession at the end of the thirty-fourth year, belonging to policy-holders, has been paid to them. The policies were all paid at maturity; the company has nothing left. In fact, it never had a cent of its own during the whole time, although we have seen it the custodian, at one time, of nearly twenty-eight millions of dollars of other people's money. It owed every cent, and it paid every cent it owed.

It is a marked peculiarity of life insurance business, as seen in this illustration, that the annual premiums exceed the death-claims for the first thirty or forty years; after which time, the losses by death largely exceed the annual premiums. The trust fund deposit, after a table of mortality and rate of interest have been designated, is a fixed mathematical amount; it increases for each policy at the end of every succeeding year of the existence of the policy.

VIII.

THE AMOUNT AT RISK.

To find the amount the company has at risk any year, subtract the amount of the deposit that must be held by the company, at the end of the year, from the amount called for by the policy.

The net annual premium is composed essentially of two parts, each of which is for a special purpose. One of these parts goes to pay, each year, the net cost of insurance on the amount the company has at risk that year, the other goes to the deposit that must be held at the end of the year.

In case a policy-holder *dies* in any year, the deposit for his policy is used by the company in part payment of this death loss; but the deposit of a policy-holder who is *alive* at the end of any year is held by the company, and is to be used in part payment of his policy when it matures.

The deposit increases year by year so long as the policy continues in force, and the amount at risk decreases as the deposit increases. During the last year of a policy that continues to the limit of the table of mortality, the amount the company has at risk is zero, because the net annual premium paid at the beginning of this year, when added to the deposit held by the company at that time, will, when increased by interest at the rate designated by law, amount, at the end of the year, to the sum called for by the policy.

Note.—The rules for determining the amount that must be held by the company, in deposit for different kinds of policies at any designated time, with the formulas and tables used in making the calculations in each case—further explanation of the amount the company has at risk from year to year—the net contributions a policy-holder is liable to be called on to pay "for death claims other than his own"—comments on the different kinds of policies—Endowments—Joint Lives—Return Premium plan—Decreasing Premium plan—Tontine Insurance—The Co-operative plan, etc., together with comments on practical life insurance, may be found in the "NOTES ON LIFE INSURANCE," previously mentioned. The following quotation is from that work:

IX.

"THE DEPOSIT WHEN A RENEWAL PREMIUM IS NOT PAID, SHOULD BE USED FOR EFFECTING FULL-PAID INSURANCE."

"IN case a life policy is not renewed by the payment of the annual premium when due, the company has in its hands the deposit intended solely for the *future* insurance of this policy. The policy-holder has paid for all the insurance the company has previously furnished him ; paid his share of the previous expenses ; contributed his proportion toward the profits, and the company holds a deposit paid by him for future insurance. It is claimed by some that the withdrawal of a policy-holder is an injury to those who remain in the company, and that on the non-payment of a renewal premium, he should forfeit the deposit held by the company.

The justice of this forfeiture is denied. So long as the death rate among the insured conforms to that given in the table of mortality, and the interest realized is that assumed, the net premiums are just sufficient to pay death losses year by year, and provide the requisite deposit for each policy.

Therefore, so far as paying death losses is concerned, and considering the *net* premiums only, it makes no difference to the company whether it has a greater or less number of policies in force, *provided* the mortality conforms to the rate designated in the table. The number insured may be 100,000 or 1,000,000 ; the company with one million of policy-holders would make no more out of the normal net contributions of each policy-holder to pay death-claims than the company with one hundred thousand policy-holders would make out of the net premiums of each of its policy-holders.

In other words, in case 900,000 policy-holders withdraw from a company containing 1,000,000, so far as net values are concerned, the company, when reduced to 100,000 policy-holders, is just exactly as strong in resources for paying death-claims as it was before the 900,000 withdrew. This is so, because when nine tenths of them withdraw, and diminish the net premiums of the company 90 per cent, their withdrawal diminishes the death-claims in just the same proportion. *Expense* incurred in the transaction of the business of a company is a different thing. The working expenses of a company consisting of 100,000 policy-holders ought to be less on each policy than that of a company consisting of 1000 policy-holders should be on each of its policies.

In estimating "the value of a policy-holder to a company to keep," we pass from the theory of net values to the consideration of ordinary business matters, such as expenses, loading, interest realized in excess of table rate, the health of the policy-holder at the time of proposed withdrawal, the cost of getting a policy-holder into the company, and whatever may have a practical bearing on the particular case. In determining what should be done with the accrued deposit in case the contract for insurance is not renewed at the beginning of any policy year, it should not be forgotten that the insurance the company furnishes is not the amount called for by the policy—it is the amount at risk, which is the face of the policy, less this deposit.

Until a very recent period, it was the custom of life insurance companies to appropriate to themselves the whole of the accrued deposit, in case the insured failed to renew the contract by paying the annual premium when due. The rights of withdrawing policy-holders in this regard are getting to be somewhat better understood, and many of the companies show a willingness, at least in part, to respect them.

The insured has no right, in equity, at his own option, to demand, at the time of withdrawal, the return to him of any portion of the deposit accrued on his policy. The original contract was for insurance; the deposit is intended to provide for future insurance; and all that the policy-holder is in equity entitled to is the insurance that this deposit will at that time effect.

In determining this amount, the future *expenses* of the policy must be provided for; and the remainder of the deposit only can be properly used as a net single premium for full-paid insurance. No further collections of premiums have to be made, and no agent's commissions thereon paid; therefore the expense will probably be little else than that attendant upon the investment and keeping of the funds. The interest actually received being usually more than the table net rate, this excess of interest might well be more than enough to cover the necessary expense upon the policy. When the accrued deposit is large, and the amount at risk consequently small compared with the policy, it seems absurd, as authorized by law in some States, to allow the company to deduct 20 per cent of the deposit, and furnish full-paid insurance for the remainder only.

This, however, is greatly better for the withdrawing policy-holders than the former system under which the company appropriated to itself the whole of the deposit in case of the non-payment of a renewal premium when due. If those who procured the passage of the State laws, just referred to, had based the deductions on the amount at risk, instead of on the amount of the deposit, it would have been more equitable.

Take, for instance, the deduction of 20 per cent of the deposit at the end of the first year; find what per cent this sum is of the amount at risk the first year. Having thus fixed the rate per cent of the amount at risk to be used in computing the sum to be deducted from the deposit, the deduction will be less as the policy grows older, instead of increasing as it does under existing laws, above referred to. For example, the deposit at the end of the first year for an ordinary life policy of $10,000, issued at age 20 (Am. Ex. 4½) is $47.36. Therefore the amount at risk the first year is $9952.64.

Twenty per cent of the deposit at the end of the first year is $9.472. This sum is equivalent to $\frac{952}{1000000}$ (which is a small fraction less than one tenth of one per cent) of the amount at risk the first year. At the end of the first year, then, the deduction of twenty per cent from the deposit gives substantially the same as a deduction of one tenth of one per cent of the amount at risk. At the end of the fiftieth policy year, the deposit is $6235.96. Therefore the amount at risk that year is $3764.04. The 20 per cent deducted before applying this deposit to the purchase of full-paid insurance is $1247.19. One tenth of one per cent of the amount at risk is $3.76.

At age 94, the deposit is $9449.72. The amount at risk during the year is $550.28. Twenty per cent, to be deducted before applying this deposit to the purchase of full-paid insurance, is $1889.94. One tenth of one per cent of the amount at risk is $0.55.

The glaring inequity of a rule that allows a deduction of $1889.94 to be made from the deposit when the whole amount at risk during the year is but $550.28 needs no comment.

It is maintained by some that the policy-holders who cease to pay renewal premiums when due are nearly always in sound health, with fair prospects for long life, and that the unhealthy policy-holders remain. This selection against the company will, it is claimed, result in a very high rate of mortality amongst those that continue.

It is not at all clear that any large proportion of policy-holders cease to pay renewal premiums merely because they are in good health. But, be this as it may, existing legal contracts must stand unless modified with the consent of all the parties ; but in contracts yet to be made the companies should not be permitted to seize upon and appropriate to themselves the accrued net value of life insurance policies. After making a deduction therefrom for future expenses, and fair compensation for diminished vitality in the company, caused by the failure to pay a renewal premium, the remainder should be used as a net single premium for full-paid insurance—the *term* of this full-paid insurance being that named in the original contract, the *amount* being determined by the net single premium."

X.

SUMMARY.

From the foregoing it follows that in order "To find what (in equity) a life insurance company owes you, in case a renewal annual premium is not paid," *First.* Determine from the data designated by law—viz.: a specified table of mortality and rate of interest per annum—what amount the company should at that time hold in deposit, to the credit of your policy. *Second.* Find the amount of paid-up insurance this deposit will then purchase.

If the company furnishes you this amount of paid-up insurance, you will have received what you are entitled to in equity. In case there is no condition in the contract to the contrary, it is believed that the courts would compel the company to grant you this paid-up insurance. If, by the terms of the contract, you are entitled to have the deposit or any portion of it returned to you at the time in question, the company owes you this; but, if no such condition is in the agreement, it is believed, the courts would not require the company to pay you anything in money, unless there was a law to that effect. And it is quite clear that no such law should be enacted. If, on the contrary, in taking out your policy, you signed an agreement to forfeit the deposit held by the company, to the credit of your policy, in case you failed to pay a renewal annual premium when due, you are cut off from demanding, at the hands of the company, either paid-up insurance, money, or anything else, on account of the accrued deposit.

If the company will not concede to you your rights under the contract *for insurance*, and your rights *in equity* that are not in conflict with the terms of the contract, advise with a competent counsellor who is acquainted with the simple principles upon which calculations of legal values in this business are based.

Prof. Wm. H. C. Bartlett, Actuary of the Mutual Life Insurance Company of New York, in a published official report to the President of the Company, 1875, says, in case a policy-holder does not pay his renewal premium when due:

"The company ought to give him paid-up insurance, and can base it upon his contribution to the reserve fund." [Called *deposit* in this discussion.] "This being done, the policy-holder has received the full value of his payments, in the commodity in which the company deals." "The theory that all the computed reserve is the individual property of the insured, to be demanded and received at will, is unsound and unsafe."

This is correct doctrine, and the sooner the business of the companies is made to conform to it the better it will be for the general interest.

In case a policy-holder is in special need of ready money, at the time his renewal premium is due and not paid, or, if the company then prefers to pay something, in money, rather than issue a policy for paid-up insurance, this becomes, at that time, a matter for mutual agreement, if practicable, between the company and the policy-holder. If they fail to agree and the paid-up insurance is issued, "the policy-holder has received the full value of his payments in the commodity in which the company deals."

The questions that arise in reference to "loading," "surplus," "dividends" (so-called), and other matters in the sphere of ordinary business principles, have not been discussed in this paper. They are alluded to at some length in the "NOTES ON LIFE INSURANCE."

After the simple method of calculating net values in life insurance is understood, this, like any other business that involves the handling and control of vast sums of money, held in trust for thousands of persons, requires to be managed by officers of strict integrity, good judgment, great industry, and sound practical sense.

"The mere fact that a man can compute interest on money will not make him a competent banker, neither will a knowledge of the formulas and rules be in itself sufficient to fit one for the important business of life insurance. But it would be far better to intrust banking to men who cannot calculate interest on money, than to intrust life insurance to those who are not acquainted with the method upon which calculations of important money values in this business are based. There is danger to all in the doctrine, often promulgated by companies and agents, that life insurance business can be better conducted by men who do not understand the 'method of calculating these values,' than by those who do understand the simple principles upon which alone this business can be safely conducted."

TABLES.

I. *The Actuaries' Table of Mortality* was deduced from the results of many years' experience of seventeen principal life insurance companies of Great Britain. In Massachusetts and some other States, this table is the legal basis on which calculations of net money values in this business are required to be made. This table shows, that out of one hundred thousand insured persons living at age 10, the number that will die between age 10 and age 11 is 676. This will leave 99,324 living at age 11, out of which number 674 will die between age 11 and age 12, and so on, giving the number living at each age and the number of those that will die before an age one year greater. At age 99 the table shows that *one* of the 100,000 living at age 10 will still be alive, and that he will die before age 100. The table also shows the percentage of deaths each year, to the number living at the beginning of the year. (See page 22.)

II. *The American Experience Table of Mortality* was deduced from the experience of the Mutual Life Insurance Company of New York. In New York and some other States, this table is the legal basis on which calculations of net money values in this business are based. Its general arrangement is similar to that of the Actuaries' Table. The oldest age given, however, is 95, at which age this table shows three persons living, all of whom, according to the table, will die before age 96. (See page 23.)

III. This table shows the amount that will, if invested at 4 per cent per annum, compounded annually, become $1 in any designated number of years, from 1 to 100. Also the amount in case the interest is at 4½ per cent. (See page 24.)

IV. Shows in detail the manner of calculating the net single premium that will insure $1 for life. This particular illustration is based on age 50. (See page 25.)

V. Shows in detail the manner of calculating the value of a life series of annual payments of $1 each. Illustration based on age 50. (See page 26.)

VI. Shows the value, at each age, of a life series of annual payments of $1 each. (See page 27.)

VII. Shows the net cost of insuring $1000 for one year, at different ages, from 20 to 70 inclusive. (See page 28.)

VIII. Shows the net single premium that will, at different ages, from 20 to 70 inclusive, insure $1000 for life. (See page 28.)

IX. Shows the net annual premium that will, at different ages, from 20 to 70 inclusive, insure $1000 for life. (See page 28.)

Note.—Casual observation of these tables may, to the general reader, indicate something intricate in this apparently formidable array of figures. Upon examination, however, it will be seen that they are arranged in numerical order, based upon ages expressed in whole years. And that for each age the tables contain specific, practical information of a very simple character. For example, suppose we take age 50. Table I. shows that, out of 69,517 insured persons living at this age, the number of these that will die before reaching age 51 is 1108, and that this year the percentage of deaths to number living is, one and five hundred and ninety-four thousandths of one per cent, expressed in decimals by the figures, .01594. Another Mortality Table, marked II., shows that, out of 69,804 insured persons living at age 50, the number of these that will die before age 51 is 962, the percentage of deaths to number living being expressed by .01378. Table IV. shows that the net single premium that will at age 50 insure $1 for life (Am. Ex. 4½ per cent) is $0.430037. It also shows the net amount that will, if paid at age 50, insure $1 in any future year to the limit of the table of mortality. Table V. illustrates the method of calculating the value at age 50 of a life series of annual payments of $1 each. Table VI. shows that at age 50 the value of a life series of annual payments of $1 each (*Actuaries*' 4 *per cent*) is $13.4703, and by *Am. Ex.* 4½ it is $13.2358018. Table VII. shows that at age 50, the net cost of insuring $1000 for one year is $15.326. Table VIII. shows that the net single premium that will, at age 50, insure $1000 for life is $481.906. Table IX. shows that the net annual premium that will, at age 50, insure $1000 for life is $35.775.

Table III. shows the amount that will, if invested at 4 per cent compound interest, become $1 in 50 years is $0.1407126: at 4½ per cent it is $0.1107096. This table gives the means for determining what any other amount will become in any designated number of years, to the limit, 100. For example, the table shows that, at 4 per cent, $0.1407126 will become $1 in 50 years. Suppose the sum invested is $147.75, instead of the amount $0.1407126, then the statement in single rule of three will be

$0.1407126 : $147.75 :: $1

is to what $147.75 will become in 50 years if invested at 4 per cent per annum, compounded annually.

At each age, and number of years, the tables give similar information to that referred to above, at age 50. When any item of this information is wanted, use the tables to find it, taking one item at a time, and getting another when needed.

TABLE I.—*Actuaries' Table of Mortality.*

Age.	Living.	Deaths.	Percentage of deaths to number living.	Age.	Living.	Deaths.	Percent'ge of deaths to number living.
10	100000	676	.00676	55	63469	1375	.02166
11	99324	674	.00679	56	62094	1436	.02313
12	98650	672	.00681	57	60658	1497	.02468
13	97978	671	.00685	58	59161	1561	.02639
14	97307	671	.00690	59	57600	1627	.02825
15	96636	671	.00694	60	55973	1698	.03034
16	95965	672	.00700	61	54275	1770	.03261
17	95293	673	.00706	62	52505	1844	.03512
18	94620	675	.00713	63	50661	1917	.03784
19	93945	677	.00721	64	48744	1990	.04083
20	93268	680	.00729	65	46754	2061	.04408
21	92588	683	.00738	66	44693	2128	.04761
22	91905	686	.00746	67	42565	2191	.05147
23	91219	690	.00756	68	40374	2246	.05563
24	90529	694	.00767	69	38128	2291	.06009
25	89835	698	.00777	70	35837	2327	.06493
26	89137	703	00789	71	33510	2351	.07016
27	88434	708	.00801	72	31159	2362	.07580
28	87726	714	.00814	73	28797	2358	.08188
29	87012	720	.00827	74	26439	2339	.08847
30	86292	727	.00842	75	24100	2303	.09556
31	85565	734	.00858	76	21797	2249	.10318
32	84831	742	.00875	77	19548	2179	.11147
33	84089	750	.00892	78	17369	2092	.12044
34	83339	758	.00909	79	15277	1987	.13006
35	82581	767	.00929	80	13290	1866	.14041
36	81814	776	.00948	81	11424	1730	.15144
37	81038	785	.00969	82	9694	1582	.16319
38	80253	795	.00991	83	8112	1427	.17591
39	79458	805	.01013	84	6685	1268	.18968
40	78653	815	.01036	85	5417	1111	.20509
41	77838	826	.01061	86	4306	958	.22248
42	77012	839	.01089	87	3348	811	.24223
43	76173	857	.01125	88	2537	673	.26527
44	75316	881	.01170	89	1864	545	.29238
45	74435	909	.01221	90	1319	427	.32373
46	73526	944	.01284	91	892	322	.36099
47	72582	981	.01352	92	570	231	.40526
48	71601	1021	.01426	93	339	155	.45723
49	70580	1063	.01506	94	184	95	.51630
50	69517	1108	.01594	95	89	52	.58427
51	68409	1156	.01690	96	37	24	.64865
52	67253	1207	.01795	97	13	9	.69231
53	66046	1261	.01909	98	4	3	.75000
54	64785	1316	.02031	99	1	1	1.00000

Table II.—*American Experience Table of Mortality.*

Age.	Number living.	Number of deaths.	Percentage of deaths to living.	Age.	Number living	Number of deaths.	Percentage of deaths to living.
10	100000	749	.00749	53	66797	1091	.01633
11	99251	746	.00752	54	65706	1143	.01735
12	98505	743	.00754	55	64563	1199	.01857
13	97762	740	.00757	56	63364	1260	.01988
14	97022	737	.00760	57	62104	1325	.02134
15	96285	735	.00763	58	60779	1394	.02293
16	95550	732	.00766	59	59385	1468	.02472
17	94818	729	.00769	60	57917	1546	.02669
18	94089	727	.00773	61	56371	1628	.02888
19	93362	725	.00777	62	54743	1713	.03129
20	92637	723	.00780	63	53030	1800	.03394
21	91914	722	.00786	64	51230	1889	.03687
22	91192	721	.00791	65	49341	1980	.04013
23	90471	720	.00796	66	47361	2070	.04371
24	89751	719	.00801	67	45291	2158	.04765
25	89032	718	.00806	68	43133	2243	.05200
26	88314	718	.00813	69	40890	2321	.05676
27	87596	718	.00820	70	38569	2391	.06199
28	86878	718	.00826	71	36178	2448	.06767
29	86160	719	.00834	72	33730	2487	.07373
30	85441	720	.00843	73	31243	2505	.08018
31	84721	721	.00851	74	28738	2501	.08703
32	84000	723	.00861	75	26237	2476	.09437
33	83277	726	.00892	76	23761	2431	.10231
34	82551	729	.00883	77	21330	2369	.11102
35	81822	732	.00895	78	18961	2291	.12083
36	81090	737	.00909	79	16670	2196	.13173
37	80353	742	.00923	80	14474	2091	.14447
38	79611	749	.00941	81	12383	1964	.15860
39	78862	756	.00959	82	10419	1816	.17429
40	78106	765	.00979	83	8603	1648	.19156
41	77341	774	.01001	84	6955	1470	.21136
42	76567	785	.01025	85	5485	1292	.23555
43	75782	797	.01052	86	4193	1114	.26568
44	74985	812	.01083	87	3079	933	.30302
45	74173	828	.01116	88	2146	744	.34669
46	73345	848	.01156	89	1402	555	.39515
47	72497	870	.01200	90	847	385	.45455
48	71627	896	.01251	91	462	246	.53247
49	70731	927	.01316	92	216	137	.63426
50	69804	962	.01378	93	79	58	.73418
51	68842	1001	.01454	94	21	18	.85714
52	67841	1044	.01539	95	3	3	1.00000

TABLE III.—*Showing the Amount that will, if invested at four per cent, or at four and a half per cent, per annum, Compounded Annually, become $1 in any designated number of Years, from* 1 *to* 100.

Years.	Amount at 4½ per cent.	Amount at 4 per cent.	Years.	Amount at 4½ per cent.	Amount at 4 per cent.
1	$0.9569378	$0.9615385	51	$0.1059422	$0.1353006
2	0.9157300	0.9245562	52	0.1013801	0.1300967
3	0.8762966	0.8889964	53	0.0970145	0.1250930
4	0.8385613	0.8548042	54	0.0928368	0.1202817
5	0.8024510	0.8219271	55	0.0888391	0.1156555
6	0.7678957	0.7903145	56	0.0850135	0.1112072
7	0.7348285	0.7599178	57	0.0813526	0.1069300
8	0.7031851	0.7306902	58	0.0778494	0.1028173
9	0.6729044	0.7025867	59	0.0744970	0.0988628
10	0.6439277	0.6755642	60	0.0712890	0.0950604
11	0.6161987	0.6495809	61	0.0682191	0.0914042
12	0.5896638	0.6245970	62	0.0652815	0.0878887
13	0.5642716	0.6005741	63	0.0624703	0.0845083
14	0.5399729	0.5774751	64	0.0597802	0.0812580
15	0.5167204	0.5552645	65	0.0572059	0.0781327
16	0.4944693	0.5339082	66	0.0547425	0.0751276
17	0.4731764	0.5133732	67	0.0523852	0.0722381
18	0.4528004	0.4936281	68	0.0501294	0.0694597
19	0.4333018	0.4746424	69	0.0479707	0.0667882
20	0.4146429	0.4563869	70	0.0459050	0.0642194
21	0.3967874	0.4388336	71	0.0439282	0.0617494
22	0.3797009	0.4219554	72	0.0420366	0.0593744
23	0.3633501	0.4057263	73	0.0402264	0.0570908
24	0.3477035	0.3901215	74	0.0384941	0.0548950
25	0.3327306	0.3751168	75	0.0368365	0.0527837
26	0 3184025	0.3606892	76	0.0352502	0.0507535
27	0.3046914	0.3468166	77	0.0337323	0.0488015
28	0.2915707	0.3334775	78	0.0322797	0.0469245
29	0.2790150	0.3206514	79	0.0308897	0.0451197
30	0.2670000	0.3083187	80	0.0295595	0.0438843
31	0.2555024	0.2964603	81	0.0282866	0.0417157
32	0.2444999	0.2850579	82	0.0270685	0.0401112
33	0.2339712	0.2740942	83	0.0259029	0.0385685
34	0.2238959	0.2635521	84	0.0247874	0.0370851
35	0.2142544	0.2534155	85	0.0237200	0.0356587
36	0.2050282	0.2436687	86	0.0226986	0.0342873
37	0.1961992	0.2342968	87	0.0217211	0.0329685
38	0.1877504	0.2252854	88	0.0207858	0.0317005
39	0.1796655	0.2166206	89	0.0198907	0.0304812
40	0.1719287	0.2082890	90	0.0190342	0.0293089
41	0.1645251	0.2002779	91	0.0182145	0.0281816
42	0.1574403	0.1925749	92	0.0174302	0.0270977
43	0.1506605	0.1851682	93	0.0166796	0.0260555
44	0.1441728	0.1780463	94	0.0159613	0.0250534
45	0.1379644	0.1711984	95	0.0152740	0.0240898
46	0.1320233	0.1646139	96	0.0146163	0.0231632
47	0.1263381	0.1582826	97	0.0139868	0.0222723
48	0.1208977	0.1521948	98	0.0133845	0.0214157
49	0.1156916	0.1463411	99	0.0128082	0.0205920
50	0.1107096	0.1407126	100	0.0122566	0.0198000

TABLE IV.—*Illustrating the manner of calculating the net Single Premium for a Whole-Life Policy for $1 ; issued at age 50. American Experience, four and a half per cent.*

Age.	Value in hand, at age 50, of $1, to be paid *certain* at the end of each respective year.		Number of Deaths.		Number living at age 50.		Value, in hand, at age 50, of $1, to be paid at the end of each respective year, *provided* the insured dies during the year.	Age.
50	$0.956938	×	962	÷	69804	=	$0.013188	50
51	0.915730	×	1001	÷	69804	=	.013132	51
52	0.876297	×	1044	÷	69804	=	.013106	52
53	0.838561	×	1091	÷	69804	=	.013106	53
54	0.802451	×	1143	÷	69804	=	.013140	54
55	0.767896	×	1199	÷	69804	=	.013190	55
56	0.734828	×	1260	÷	69804	=	.013264	56
57	0.703185	×	1325	÷	69804	=	.013348	57
58	0.672904	×	1394	÷	69804	=	.013438	58
59	0.643928	×	1468	÷	69804	=	.013542	59
60	0.616199	×	1546	÷	69804	=	.013647	60
61	0.589664	×	1628	÷	69804	=	.013752	61
62	0.564272	×	1713	÷	69804	=	.013847	62
63	0.539973	×	1800	÷	69804	=	.013924	63
64	0.516720	×	1889	÷	69804	=	.013983	64
65	0.494469	×	1980	÷	69804	=	.014026	65
66	0.473176	×	2070	÷	69804	=	.014032	66
67	0.452800	×	2158	÷	69804	=	.013998	67
68	0.433302	×	2243	÷	69804	=	.013923	68
69	0.414643	×	2321	÷	69804	=	.013787	69
70	0.396787	×	2391	÷	69804	=	.013591	70
71	0.379701	×	2448	÷	69804	=	.013316	71
72	0.363350	×	2487	÷	69804	=	.012946	72
73	0.347703	×	2505	÷	69804	=	.012478	73
74	0.332731	×	2501	÷	69804	=	.011921	74
75	0.318402	×	2476	÷	69804	=	.011294	75
76	0.304691	×	2431	÷	69804	=	.010611	76
77	0.291571	×	2369	÷	69804	=	.009895	77
78	0.279015	×	2291	÷	69804	=	.009157	78
79	0.267000	×	2196	÷	69804	=	.008400	79
80	0.255502	×	2091	÷	69804	=	.007654	80
81	0.244500	×	1964	÷	69804	=	.006879	81
82	0.233971	×	1816	÷	69804	=	.006087	82
83	0.223896	×	1648	÷	69804	=	.005286	83
84	0.214254	×	1470	÷	69804	=	.004512	84
85	0.205028	×	1292	÷	69804	=	.003795	85
86	0.196199	×	1114	÷	69804	=	.003131	86
87	0.187750	×	933	÷	69804	=	.002509	87
88	0.179665	×	744	÷	69804	=	.001915	88
89	0.171929	×	555	÷	69804	=	.001367	89
90	0.164525	×	385	÷	69804	=	.000907	90
91	0.157440	×	246	÷	69804	=	.000555	91
92	0.150661	×	137	÷	69804	=	.000296	92
93	0.144173	×	58	÷	69804	=	.000120	93
94	0.137964	×	18	÷	69804	=	.000036	94
95	0.132023	×	3	÷	69804	=	.000006	95
	Total..................						$0.430037	

If the insurance is for a limited number of years only, the calculation is made for each year of the term, and the sum of these yearly amounts will give the net single premium that will, if paid at the time the policy is issued, insure $1 to be paid to the heirs of the insured at the end of the year in which the policy-holder may die; *provided* he dies before the expiration of the term.

TABLE V.—*Illustrating the manner of calculating the value, at age 50, of a Whole-Life Series of Annual Payments of* $1 *each—the first payment to be immediate, and one at the beginning of each following year, as long as the person is alive to make the payment. American Experience, four and a half per cent.*

Age.	Value in hand, at age 50, of $1, to be paid *certain* at the beginning of each year.		Number living at beginning of each year. *Numerator.*		Number living at age 50. *Denominator.*		Value in hand, at age 50, of $1, to be paid at the beginning of each respective year, provided the person is alive to make the payment.	Age.
50	$1.000000	×	69804	÷	69804	=	$1.000000	50
51	0.956938	×	68842	÷	69804	=	0.943750	51
52	0.915730	×	67841	÷	69804	=	0.889978	52
53	0.876297	×	66797	÷	69804	=	0.838548	53
54	0.838561	×	65706	÷	69804	=	0.789331	54
55	0.802451	×	64563	÷	69804	=	0.742202	55
56	0.767896	×	63364	÷	69804	=	0.697051	56
57	0.734828	×	62104	÷	69804	=	0.653770	57
58	0.703185	×	60779	÷	69804	=	0.612270	58
59	0.672904	×	59385	÷	69804	=	0.572466	59
60	0.643928	×	57917	÷	69804	=	0.534273	60
61	0.616199	×	56371	÷	69804	=	0.497619	61
62	0.589664	×	54743	÷	69804	=	0.462437	62
63	0.564272	×	53030	÷	69804	=	0.428677	63
64	0.539973	×	51230	÷	69804	=	0.396293	64
65	0.516720	×	49341	÷	69804	=	0.365244	65
66	0.494469	×	47361	÷	69804	=	0.335490	66
67	0.473176	×	45291	÷	69804	=	0.307011	67
68	0.452800	×	43133	÷	69804	=	0.279792	68
69	0.433302	×	40890	÷	69804	=	0.253821	69
70	0.414643	×	38569	÷	69804	=	0.229104	70
71	0.396787	×	36178	÷	69804	=	0.205647	71
72	0.379701	×	33730	÷	69804	=	0.183475	72
73	0.363350	×	31243	÷	69804	=	0.162629	73
74	0.347703	×	28738	÷	69804	=	0.143148	74
75	0.332731	×	26237	÷	69804	=	0.125063	75
76	0.318402	×	23761	÷	69804	=	0.108383	76
77	0.304691	×	21330	÷	69804	=	0.093104	77
78	0.291571	×	18961	÷	69804	=	0.079200	78
79	0.279015	×	16670	÷	69804	=	0.066632	79
80	0.267000	×	14474	÷	69804	=	0.055363	80
81	0.255502	×	12383	÷	69804	=	0.045325	81
82	0.244500	×	10419	÷	69804	=	0.036494	82
83	0.233971	×	8603	÷	69804	=	0.028836	83
84	0.223896	×	6955	÷	69804	=	0.022308	84
85	0.214254	×	5485	÷	69804	=	0.016835	85
86	0.205028	×	4193	÷	69804	=	0.012316	86
87	0.196199	×	3079	÷	69804	=	0.008654	87
88	0.187750	×	2146	÷	69804	=	0.005772	88
89	0.179665	×	1402	÷	69804	=	0.003609	89
90	0.171929	×	847	÷	69804	=	0.002086	90
91	0.164525	×	462	÷	69804	=	0.001089	91
92	0.157440	×	216	÷	69804	=	0.000487	92
93	0.150661	×	79	÷	69804	=	0.000171	93
94	0.144173	×	21	÷	69804	=	0.000043	94
95	0.137964	×	3	÷	69804	=	0.000006	95
	Total						$13.235802	

NOTE.—The remarks that follow the table illustrating the calculation of the net single premium that will insure $1 for life, apply to the value, at any age, of a series of annual payments of $1 for a designated term of years.

TABLE VI.—*Value at each age of a Life Series of Annual Payments of $1 each ; the first immediate.*

Age.	American Experience 4½ per cent.	Age.	Actuaries' 4 per cent.	Age.	American Experience 4½ per cent.	Age.	Actuaries' 4 per cent.
10	$18.855 2865	10	$20.4536	55	$11.821 8465	55	$11.9779
11	18.799 5832	11	20.3694	56	11.522 8199	56	11.6698
12	18.741 4307	12	20.2818	57	11.219 4467	57	11.3593
13	18.680 6991	13	20.1907	58	10.912 1342	58	11.0463
14	18.617 2521	14	20.0959	59	10.601 3275	59	10.7311
15	18.550 9454	15	19.9976	60	10.287 6997	60	10.4147
16	18.481 8206	16	19.8957	61	9.971 8279	61	10.0977
17	18.409 5363	17	19.7901	62	9.654 3796	62	9.7805
18	18.333 9242	18	19.6807	63	9.335 9646	63	9.4641
19	18.255 0022	19	19.5675	64	9.017 1527	64	9.1489
20	18.172 5961	20	19.4504	65	8.698 6699	65	8.8356
21	18.086 5220	21	19.3293	66	8.381 4484	66	8.5248
22	17.996 7833	22	19.2042	67	8.066 1600	67	8.2170
23	17.903 1882	23	19.0747	68	7.753 5753	68	7.9130
24	17.805 5344	24	18.9410	69	7.444 6209	69	7.6130
25	17.703 6080	25	18.8027	70	7.139 9044	70	7.3172
26	17.597 1831	26	18.6598	71	6.840 2460	71	7.0261
27	17.486 2208	27	18.5122	72	6.545 9947	72	6.7400
28	17.370 4817	28	18.3597	73	6.256 9020	73	6.4593
29	17.249 7130	29	18.2022	74	5.972 3102	74	6.1840
30	17.123 8475	30	18.0397	75	5.691 3706	75	5.9146
31	16.992 6152	31	17.8718	76	5.413 3424	76	5.6512
32	16.855 7300	32	17.6985	77	5.137 5702	77	5.3938
33	16.713 0898	33	17.5196	78	4.863 9745	78	5.1428
34	16.564 5871	34	17.3350	79	4.592 7856	79	4.8986
35	16.409 9079	35	17.1443	80	4.324 0890	80	4.6607
36	16.248 7188	36	16.9476	81	4.060 2393	81	4.4290
37	16.081 0666	37	16.7443	82	3.800 7694	82	4.2026
38	15.906 6002	38	16.5342	83	3.544 6260	83	3.9802
39	15.725 3451	39	16.3172	84	3.289 2139	84	3.7611
40	15.536 9284	40	16.0929	85	3.033 3545	85	3.5436
41	15.341 3492	41	15.8610	86	2.779 5927	86	3.3279
42	15.138 2074	42	15.6212	87	2.532 5153	87	3.1138
43	14.927 4700	43	15.3736	88	2.297 7410	88	2.9012
44	14.708 8998	44	15.1186	89	2.075 8025	89	2.6911
45	14.482 6303	45	14 8571	90	1.860 8589	90	2.4854
46	14.248 4049	46	14.5896	91	1.649 2622	91	2.2843
47	14.006 5237	47	14.3170	92	1.451 1912	92	2.0902
48	13.756 9070	48	14.0394	93	1.289 1504	93	1.9065
49	13.499 8407	49	13.7572	94	1.136 7054	94	1.7369
				95	1.000 0000		
50	13.235 8018	50	13.4703			95	1.5843
51	12.965 0906	51	13.1792			96	1.4618
52	12.688 0262	52	12.8841			97	1.3670
53	12.404 8683	53	12.5853			98	1.2404
54	12.115 9785	54	12.2832			99	1.0000

TABLE VII.—*Showing the Net Cost of Insuring* $1000 *for One Year, at different Ages, from* 20 *to* 70, *inclusive.* (*Actuaries' Table of Mortality—Interest at four per cent.*)

Age.		Age.		Age.	
20	$7.010	37	$9.314	54	$19.532
21	7.093	38	9.525	55	20.831
22	7.177	39	9.741	56	22.237
23	7.273	40	9.963	57	23.730
24	7.371	41	10.204	58	25.371
25	7.471	42	10.476	59	27.160
26	7.583	43	10.818	60	29.169
27	7.698	44	11.247	61	31.357
28	7.826	45	11.742	62	33.770
29	7.956	46	12.345	63	36.384
30	8.101	47	12.996	64	39.255
31	8.248	48	13.711	65	42.386
32	8.410	49	14.482	66	45.782
33	8.576	50	15.326	67	49.494
34	8.746	51	16.248	68	53.490
35	8.931	52	17.257	69	57.776
36	9.122	53	18.359	70	62.436

TABLE VIII.—*Showing the Net Single Premium that will, at different Ages, from* 20 *to* 70, *inclusive, Insure* $1000 *for Life.* (*Actuaries' Table of Mortality—Interest at four per cent.*)

Age.		Age.		Age.	
20	$251.907	37	$355.989	54	$527.567
21	256.564	38	364.065	55	539.312
22	261.377	39	372.414	56	551.157
23	266.357	40	381.040	57	563.103
24	271.500	41	389.960	58	575.142
25	276.816	42	399.183	59	587.257
26	282.312	43	408.709	60	599.433
27	287.990	44	418.515	61	611.628
28	293.856	45	428.571	62	623.826
29	299.913	46	438.862	63	635.995
30	306.168	47	449.346	64	648.120
31	312.624	48	460.022	65	660.171
32	319.289	49	470.878	66	672.124
33	326.167	50	481.906	67	683.968
34	333.267	51	493.107	68	695.654
35	340.600	52	504.460	69	707.192
36	348.170	53	515.949	70	718.569

TABLE IX.—*Showing the Net Annual Premium that will, at different Ages, from* 20 *to* 70, *inclusive, Insure* $1000 *for Life.* (*Actuaries' Table of Mortality—Interest at four per cent.*)

Age.		Age.		Age.	
20	$12.948	37	$21.260	54	$42.950
21	13.273	38	22.018	55	45.025
22	13.610	39	22.823	56	47.230
23	13.963	40	23.677	57	49.571
24	14.334	41	24.586	58	52.067
25	14.722	42	25.554	59	54.724
26	15.129	43	26.585	60	57.556
27	15.557	44	27.682	61	60.572
28	16.005	45	28.845	62	63.782
29	16.477	46	30.080	63	67.199
30	16.972	47	31.385	64	70.841
31	17.492	48	32.767	65	74.718
32	18.040	49	34.227	66	78.846
33	18.616	50	35.775	67	83.237
34	19.225	51	37.415	68	87.913
35	19.866	52	39.151	69	92.892
36	20.544	53	40.996	70	98.202

NOTES ON LIFE INSURANCE.

(THIRD EDITION.)

BY

GUSTAVUS W. SMITH.

D. VAN NOSTRAND,

23 MURRAY STREET NEW YORK.

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THE following extract is from an editorial article in *The Chronicle,* 145 Broadway, New York. December 21, 1876.

"The first edition of this work, which is from the pen of Gustavus W. Smith, late the insurance commissioner of Kentucky, was published in pamphlet form in 1870, and received at that time great commendation from the leading actuaries and mathematicians of the country.

"It has now passed to a third edition, revised, enlarged, and much improved, making a well-bound volume of more than 200 pages, and is beyond doubt the most clear and complete exposition of the principles and mathematics of life insurance extant. It is worthy of a place in every private and public library, and is indispensable to an insurance library.

"Part first is a plain explanation and discussion of the principles upon which the calculations of net premiums and net values in life insurance are based.

"Part second refers to the practical business, and will prove interesting to those who are insured. All who contemplate insuring their lives should, in case they are not already conversant with the subject, read it carefully.

"The appendix contains an algebraic discussion, which is well worthy of attention on the part of those who are acquainted with the method of solving equations involving one unknown quantity of the first degree.

"The formulas and tables in the appendix afford means for calculating the net premiums and reserves in every kind of life insurance policy.

"It is evident that the author intended to be understood by intelligent readers. He has succeeded in making a subject, which by many is considered intricate and incomprehensible, intelligible to ordinary minds. Policyholders and the public will, in this book, find easy access to the 'mysteries' in which some have sought to veil a business that should be exposed in the clearest light. The schoolhouse and the press ought to take up this matter, not in the interest of companies or their agents, but in that of the public and its coming generations. Sound, well-managed companies have nothing to fear, but every thing to hope, from the most thorough discussion of their plans and management. Prof. A. L. PERRY, of Williams College, said of the first edition :

"'I have read this book with great care, and, I may add, with great interest. It has cleared up to my mind a subject of which I was totally ignorant before, although I have had three policies on my life for several years. In taking them out and paying the annual premium, I have walked by faith and not by sight. I believe I know now the whys and wherefores, as well as the *modus operandi.*'

"This third edition is a marked improvement on the first in every respect. We sincerely hope that the book in its improved form will find a liberal circulation, both among professionals and the public, for it is a timely publication, and entirely worthy of its author's reputation as an insurance writer."

The following notice, of the new edition of Smith's "Notes on Life Insurance," is taken from the issue of the *Boston Globe* of January 8, 1877 :

"In this volume of 'Notes on Life Insurance,' the subject is considered both theoretically and practically, and the workings of the system are thus brought out in connection with its underlying principles. These notes, as the author, Gustavus W. Smith, late Insurance Commissioner of Kentucky, says in his Introduction, are intended to be suggestive, his purpose being, not to force conclusions on the mind of any one, but to place before the reader unfamiliar with the theory, the means by which to judge for himself in reference to the principles, data, and rules used in calculating money values in Life Insurance. Recent events amply emphasize the need of a thorough knowledge of these matters for the safety of the public, and the fact that the business is exceptional in its opportunities for fraud or dangerous mistake should lead to a thorough recognition of the facts which this volume is designed to set forth. The work is divided into two parts, the first relating to theory (arithmetical discussion), the second to practical life insurance, while an appendix is devoted to algebraic discussion. This is the third edition of this work, which has been revised, enlarged, and rearranged, and in its present form is worthy the study and attention of all who are interested in a subject of such vital importance to individuals and the public."

The following is from an editorial article in the *Lexington* (Va.) *Gazette*, January 5, 1877.

"We have read with interest and pleasure the third edition of Gen. Gustavus W. Smith's 'Notes on Life Insurance,' published by D. Van Nostrand, of New York. It is very intelligible on a subject usually regarded as incomprehensible by the masses of even intelligent business men. The style of this book is so simple, and the calculations and illustrations are so clear, that any clever business man who is familiar with the ordinary operations of arithmetic, may master the subject as presented in the first and second parts of the book ; and a moderate acquaintance with algebra, such as we still retain, is sufficient to understand the calculations and the formulæ of the appendix. . . . . . To persons who are considering the question of insuring their lives, this book will be serviceable ; and those who, walking by faith, have had their lives insured already, may find it interesting to ascertain the principles and the calculations upon which they have acted."

Prof. WM. G. PECK, of Columbia College, New York, in a letter to the author, says of this work :

"I have read your manual entitled 'Notes on Life Insurance,' and find it to be an admirable compendium of all that is necessary for any one, not a professional actuary, to know on the subject.

"It is *clear* in exposition, *concise* in statement, and consecutive in arrangement—three qualities that can hardly fail to commend it to the attention of those for whose use it was prepared. It should be read not only by every Life Insurance officer, but by every other person who takes an intelligent interest in a subject of such vast importance to the whole community."

The Professor of Mathematics, in the Virginia Military Institute, says, in a letter addressed to its President :

"I have read with interest Gen. G. W. Smith's 'Notes on Life Insurance.' His treatment of the subject impresses one as thoroughly candid and scientific, without the suggestion of a desire to promote the interests of a speculation.

He very fully and clearly develops the principles upon which life insurance is based, establishes grounds for the confidence of the *insured;* and demonstrates the conditions upon which the stability of the *Insuring Company* depends.

"The subject appears to me to have been most ably and admirably treated, and I regard the work as one of great practical value."

The publisher does not consider it necessary to give here further extracts from the great number of highly favorable notices the third edition of this work has received from the press and leading men of the country. He will call attention to three only, of the many notices of the first edition, published in 1870.

Prof. WILLIAM H. C. BARTLETT, Actuary of the Mutual Life Insurance Company of New York, says:

"It gives me great pleasure to say that the *Notes on Life Insurance,* by Gen. G. W. Smith, is a very valuable contribution to our stock of information on the subject, and I very heartily commend the work to public favor. It should be in the hands of every insurance agent in the country."

Hon. OLIVER PILLSBURY, Insurance Commissioner of New Hampshire, says:

"I have been much interested in your 'Notes.' They are all that I expected, and more. I wish they could be scattered as leaves of the forest, all abroad. You have literally turned the mysteries of Life Insurance inside out, and rendered them susceptible of comprehension by ordinary reflecting minds. I consider the unpretending pamphlet worth more to me than all the elaborated volumes I have ever purchased. Your style is peculiarly adapted to the common people."

Prof. DAVID MURRAY, of Rutgers College, New Brunswick, N. J., says:

"I have read the *Notes on Life Insurance* with the greatest interest. I am free to say that I consider it the best popular explanation of the theory and practice of Life Insurance that I know. I have examined, with constantly increasing admiration, the lucid development of, to most, a complicated and difficult subject. It seems to me exactly fitted to be put into the hands of the officers and agents of all our life companies, in order that they may be furnished with something more than a mere 'routine' knowledge of their business."